BC Reconstruction

Fermilab Meeting, October 2004

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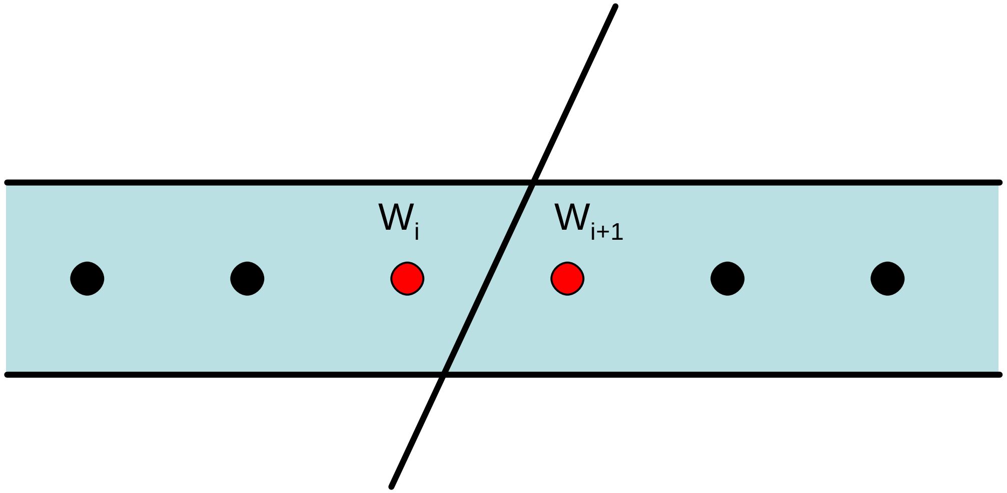
- Algorithm by E.P. Hartouni
  1. Hit Association
  2. Track Finding
  3. View Matching
  4. Track Fitting
- Tuning Algorithm Parameters
- Event Display Examples
- Fitting Performance
- Summary & Future Work

Algorithm

1. Hit Association
   - Goal: reduce the number of first and last chamber combinations
   - Adjacent hits within each plane are found and grouped together



Algorithm

2. Track Finding

- Loops through all pairs of associated hits in BC1 and BC3. Every pair of hits defines a line which intersects BC2 in that view (*u, v, s, t*)

  $w^*_{2ij} = c_1\, w_{2i} + c_2\, w_{3j}$
- Search a road ±n wires wide around the prediction w^*_{2ij} in the list of hits BC2
- Pairs passing this test are kept in the track candidate list (CandPair_t fCandTrk)

Algorithm

3. View Matching
   - Loop over track candidate list in *u*-*s* views
   - Predict wire indices in complementary views: 6 predictions are made
   - Final test: 5 out of 6 predictions find a hit within the road ±n around the predicted wire.
   - Form straight line 3D trajectory (CandTrajectory_t fCandTraj)
   - Repeat with *v*-*t* views

Algorithm

4. Track Fitting (not from Hartouni’s algorithm)

- Takes candidate trajectories and performs a least-square fit with 12 planes to 4 parameters (x_1, y_1, x_3, y_3)
- TMinuit: find the minimum value of a multi-parameter function
- Minimization function:

$$c^2 = \frac{\sum_{i=1}^{n} \text{distance}[w_i, \text{Predicted Track}]^2}{s^2/12}; \quad \text{Reduced } c^2 = \frac{1}{n}\frac{\sum_{i=1}^{n} \text{distance}[w_i, \text{Predicted Track}]^2}{s^2/12}$$

where σ= wire spacing, 0.1016 cm

w_i = wire assigned to track candidate

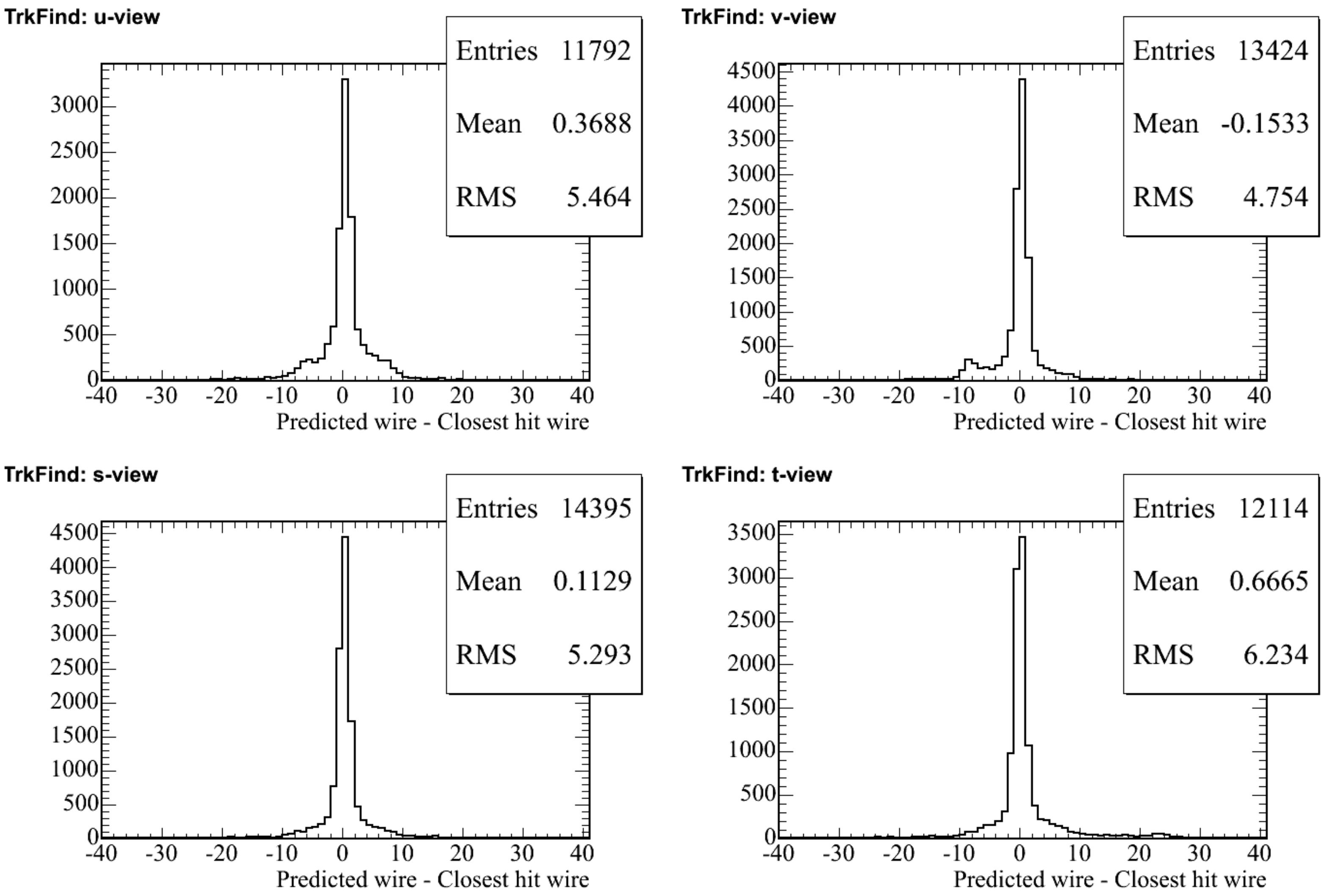
n = number of hit plane, n_{max}=12

- If all ($x_{1,trk\ i}$-$x_{1,trk\ j}$), ($y_{1,trk\ i}$-$y_{1,trk\ j}$), ($x_{3,trk\ i}$-$x_{3,trk\ j}$) and ($y_{3,trk\ i}$-$y_{3,trk\ j}$) are < 0.4 cm , keep only the track with best χ^2

Testing

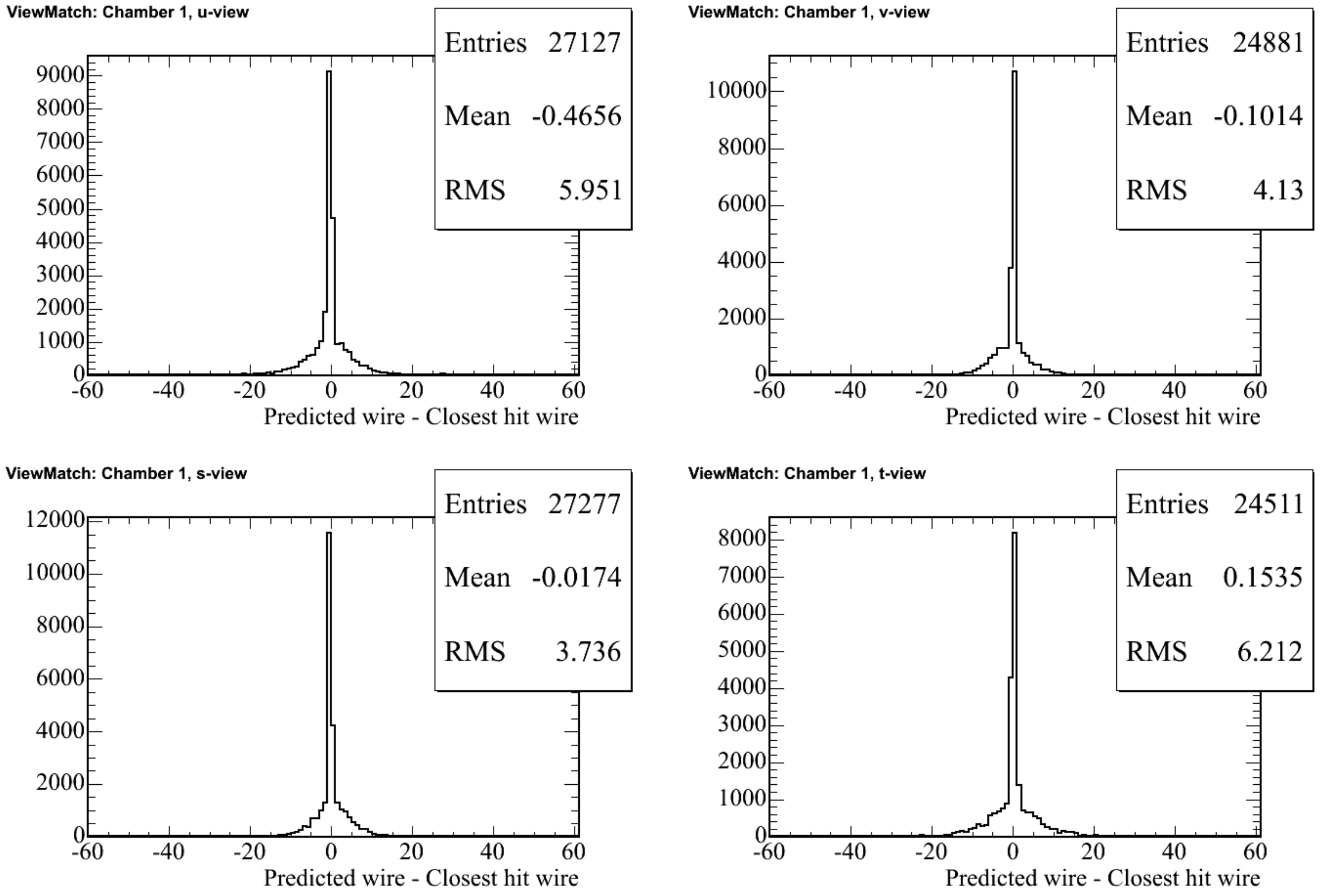
- Data file: Run# 8836 (first 10,000 events)
- Prior cut: eliminate all events with nhits/plane>5
  - More hits/plane requires more iterations
  - Time consuming
- Goals: Determine *n* in Track Finding and *n* in View Matching

Determine *n* in Track Finding

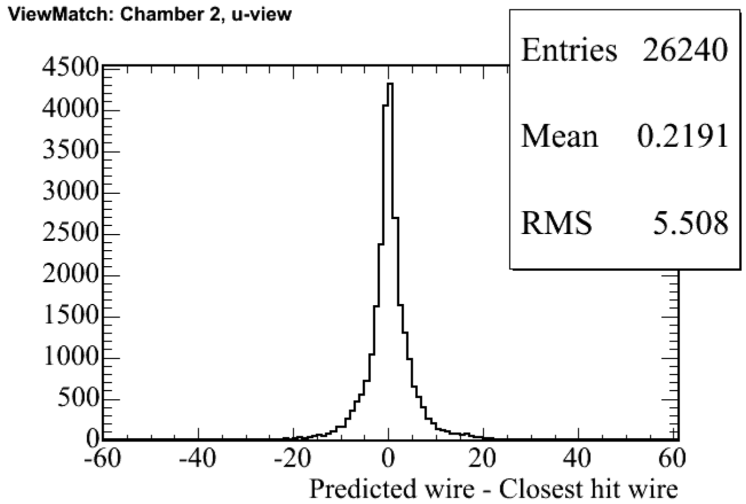


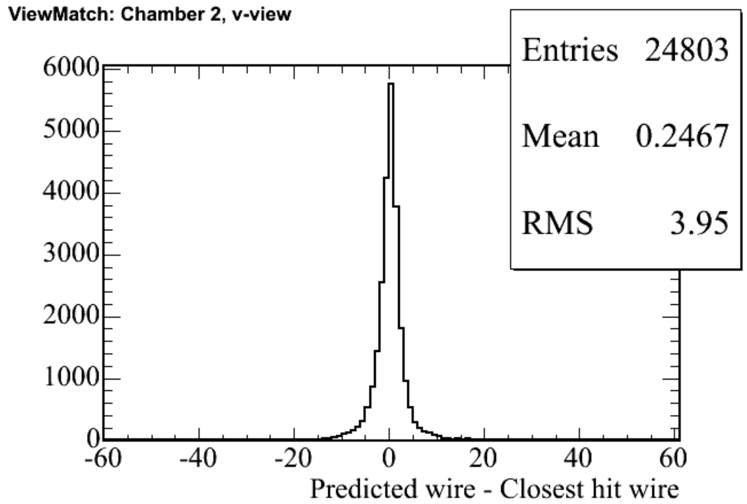
Choose n = ±5

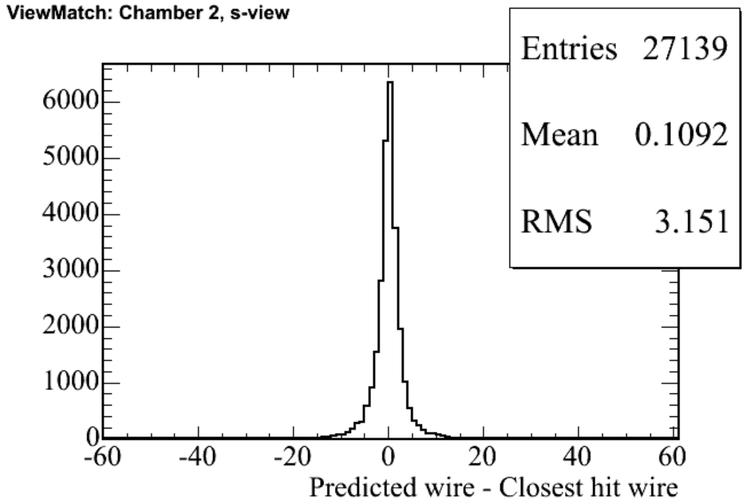
Determine *n* in View Matching (BC1)

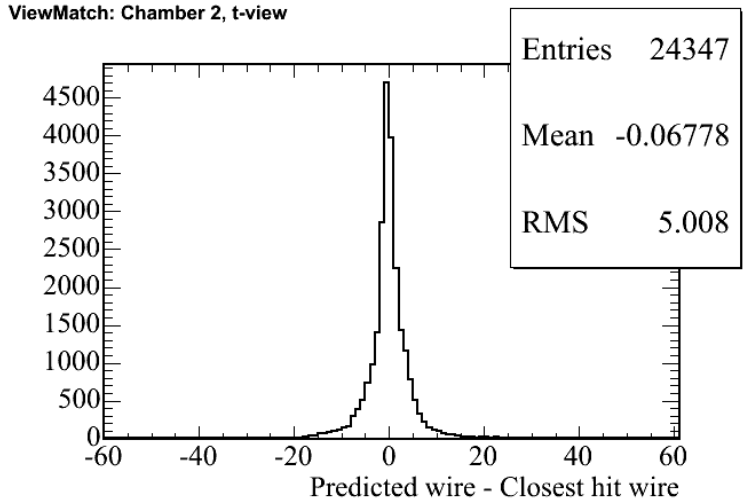


Determine *n* in View Matching (BC2)

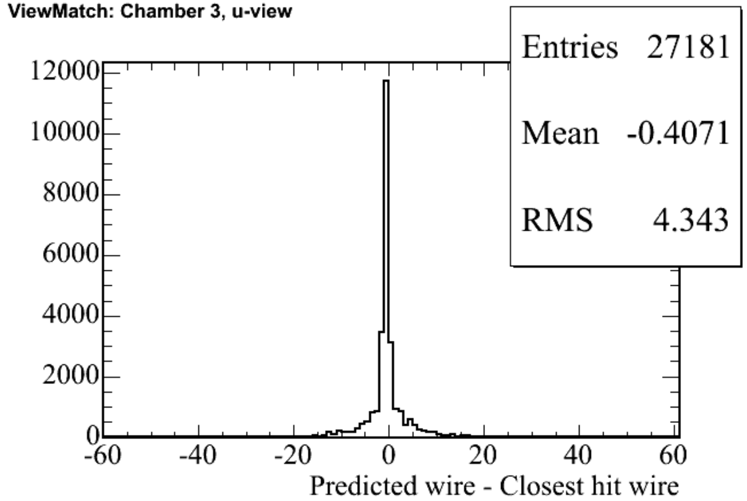


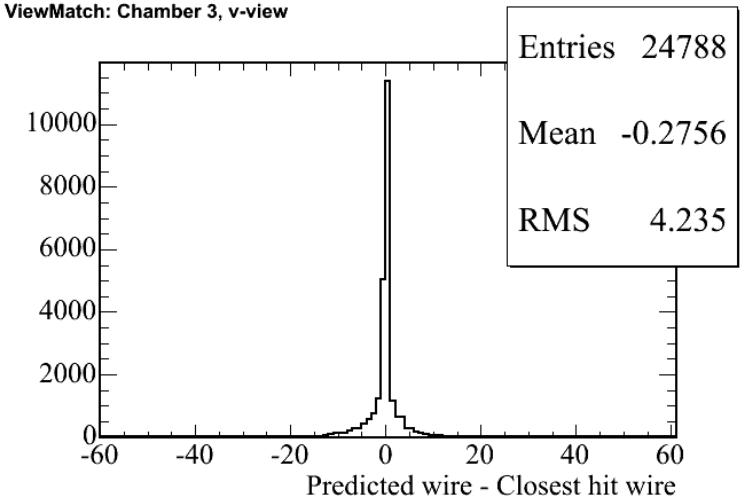


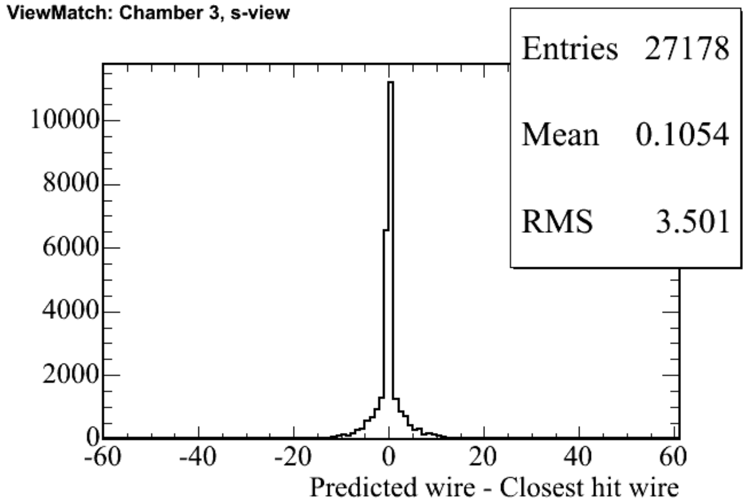


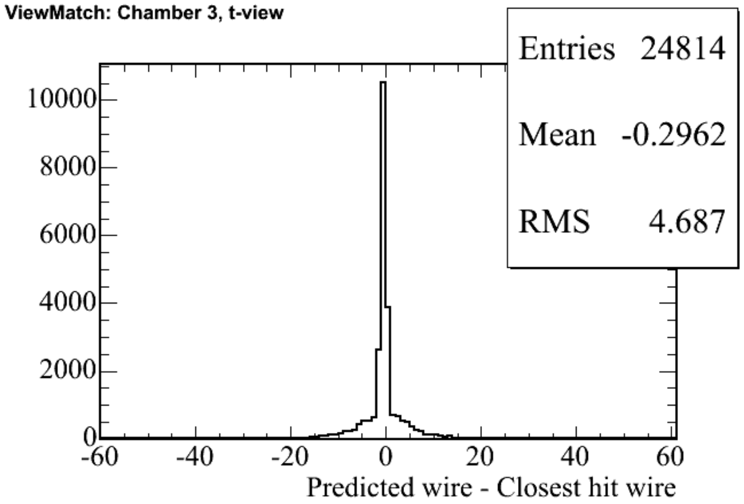


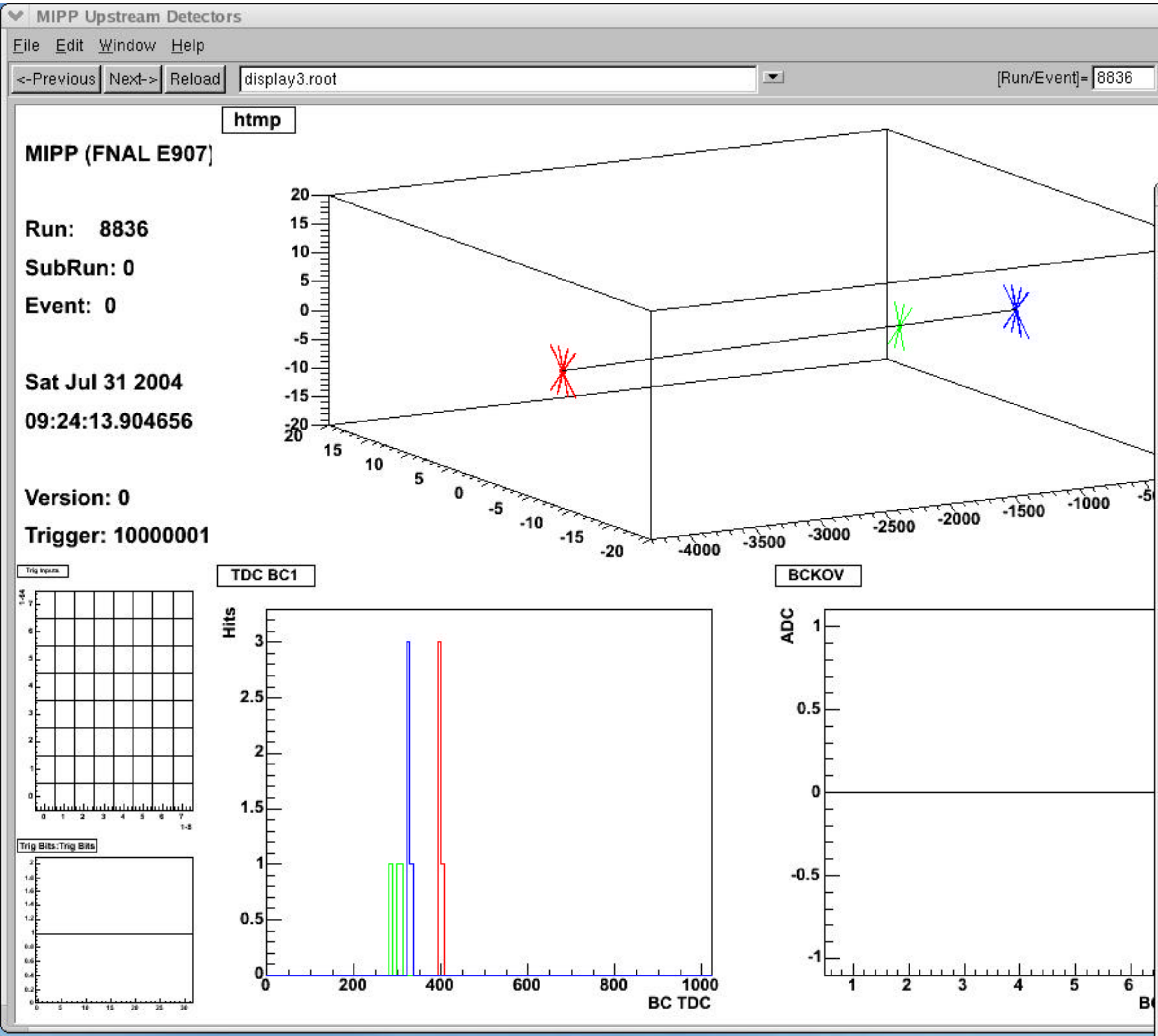
Determine *n* in View Matching (BC3)











display3.root

[Run/Event]= 8836 0

MIPP (FNAL E907)

Run: 8836

SubRun: 0

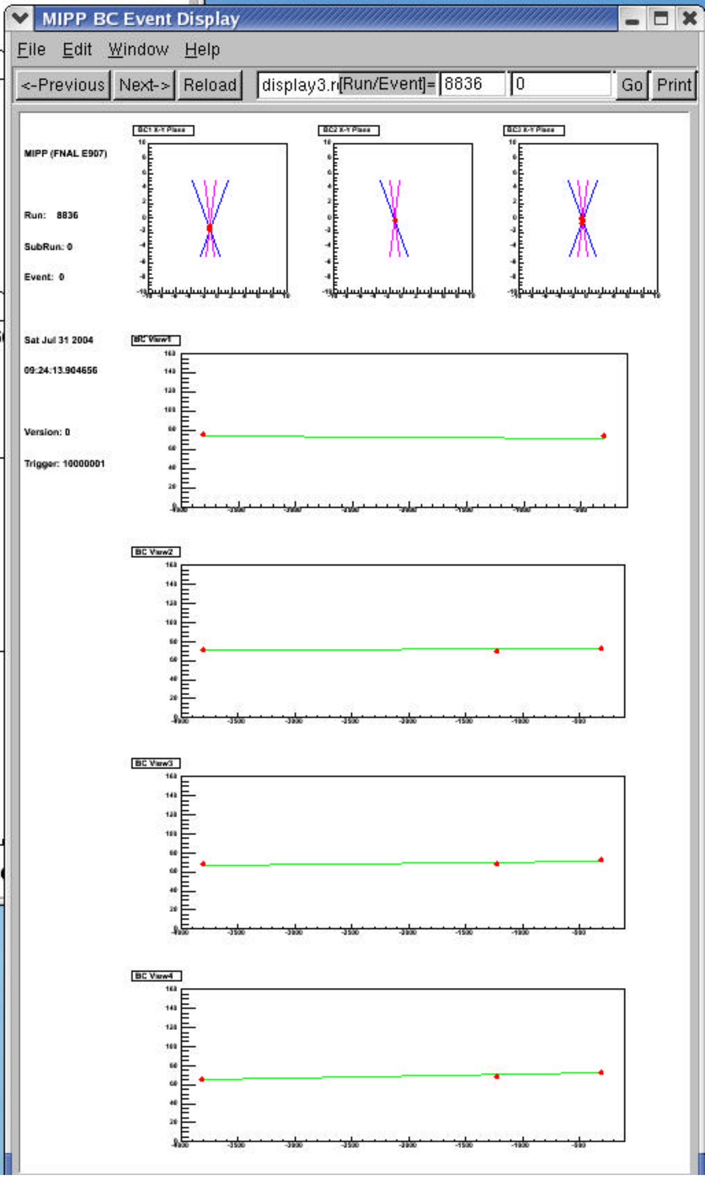
Event: 0

Sat Jul 31 2004

09:24:13.904656

Version: 0

Trigger: 10000001



display3.r [Run/Event]= 8836 0

MIPP (FNAL E907)

Run: 8836

SubRun: 0

Event: 0

Sat Jul 31 2004

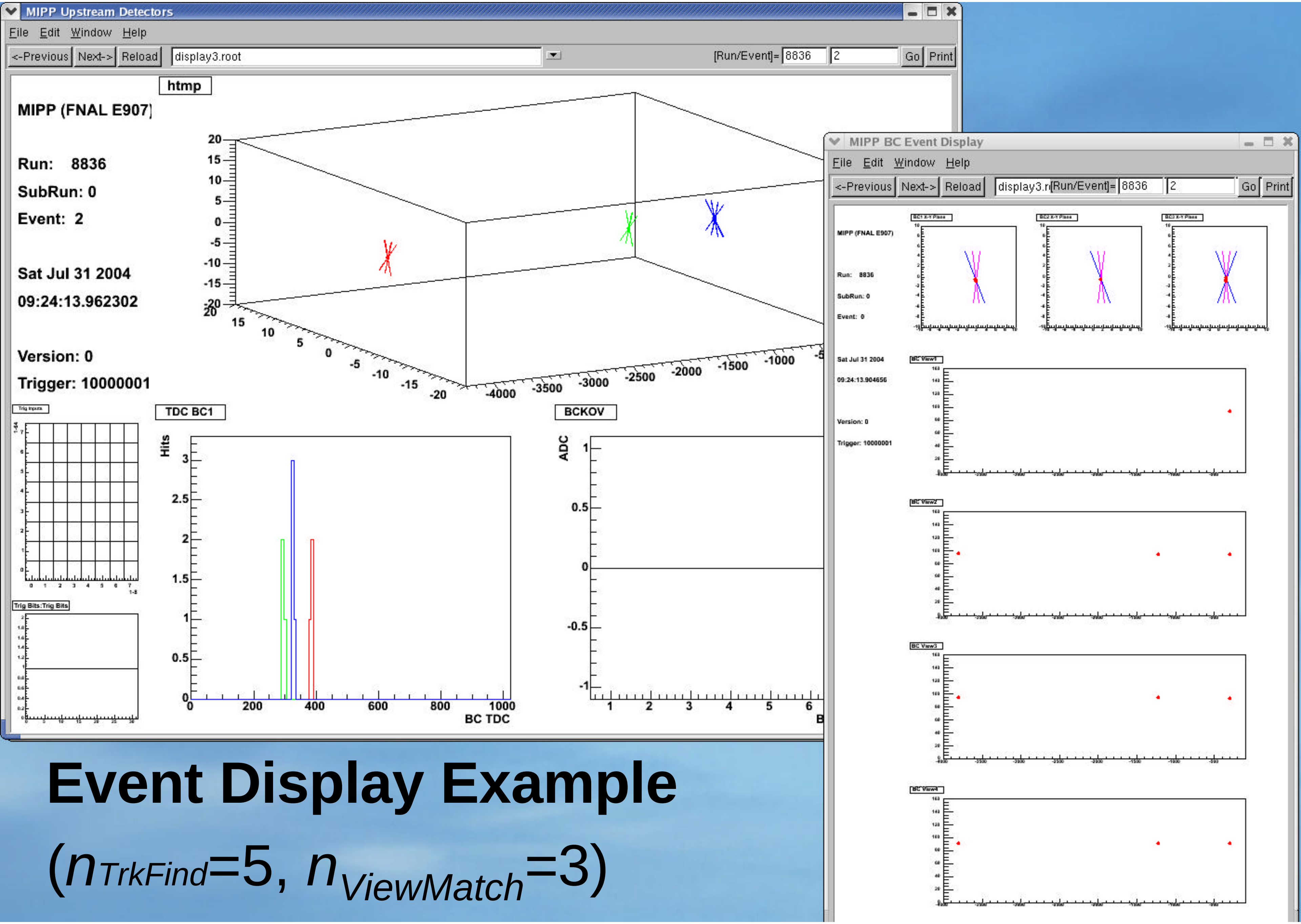
09:24:13.904656

Version: 0

Trigger: 10000001

Event Display Example

($n_{TrkFind}$=5, $n_{ViewMatch}$=3)



display3.root

[Run/Event]= 8836 2

MIPP (FNAL E907)

Run: 8836

SubRun: 0

Event: 2

Sat Jul 31 2004

09:24:13.962302

Version: 0

Trigger: 10000001

MIPP (FNAL E907)

Run: 8836

SubRun: 0

Event: 0

Sat Jul 31 2004

09:24:13.904656

Version: 0

Trigger: 10000001

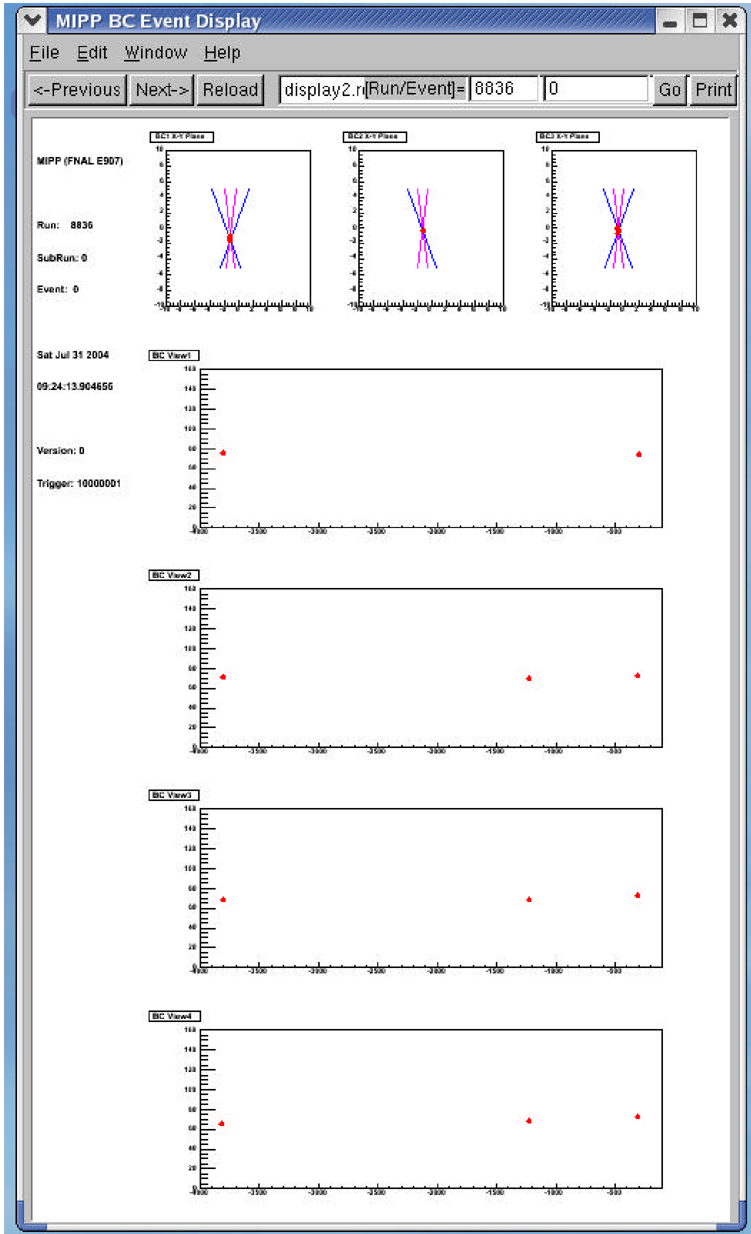
Event Display Example

($n_{TrkFind}$=5, $n_{ViewMatch}$=3)

Event Display Example ($n_{TrkFind}$=5)

$n_{ViewMatch}$=2

$n_{ViewMatch}$=4



display2.r [Run/Event]= 8836 0

MIPP (FNAL E907)

Run: 8836

SubRun: 0

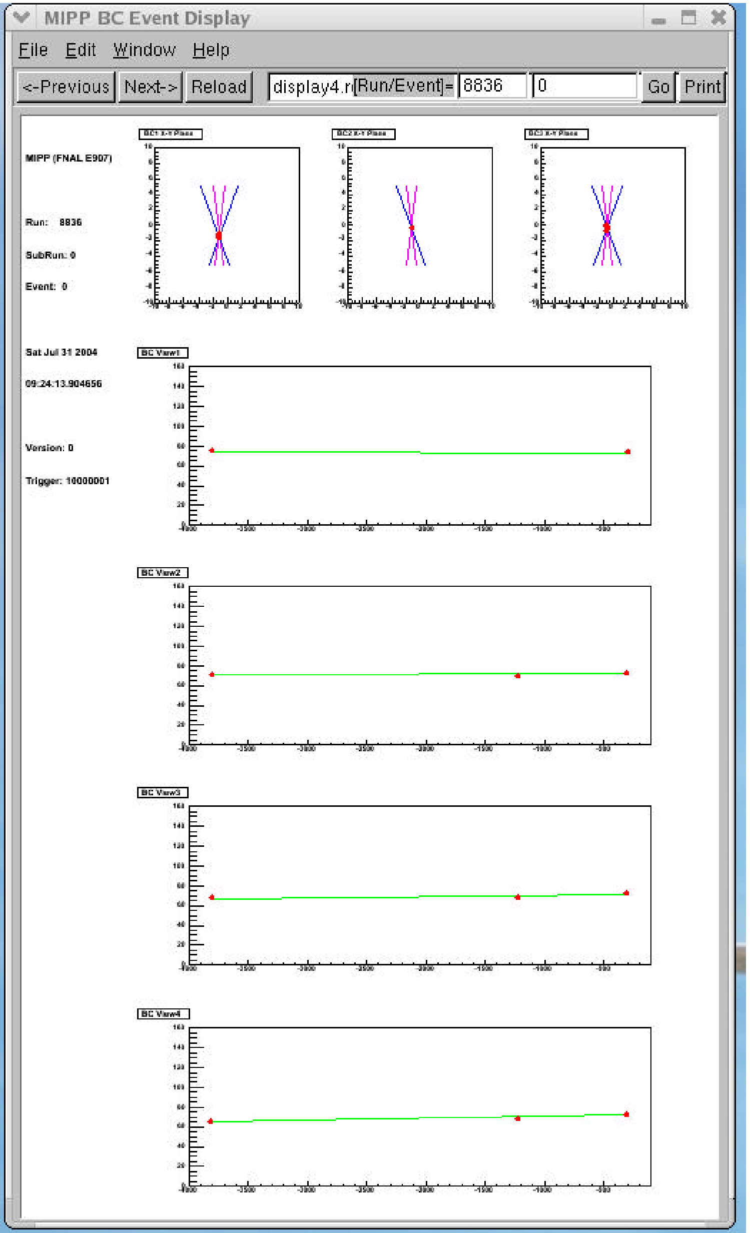
Event: 0

Sat Jul 31 2004

09:24:13.904656

Version: 0

Trigger: 10000001



display4.r [Run/Event]= 8836 0

MIPP (FNAL E907)

Run: 8836

SubRun: 0

Event: 0

Sat Jul 31 2004

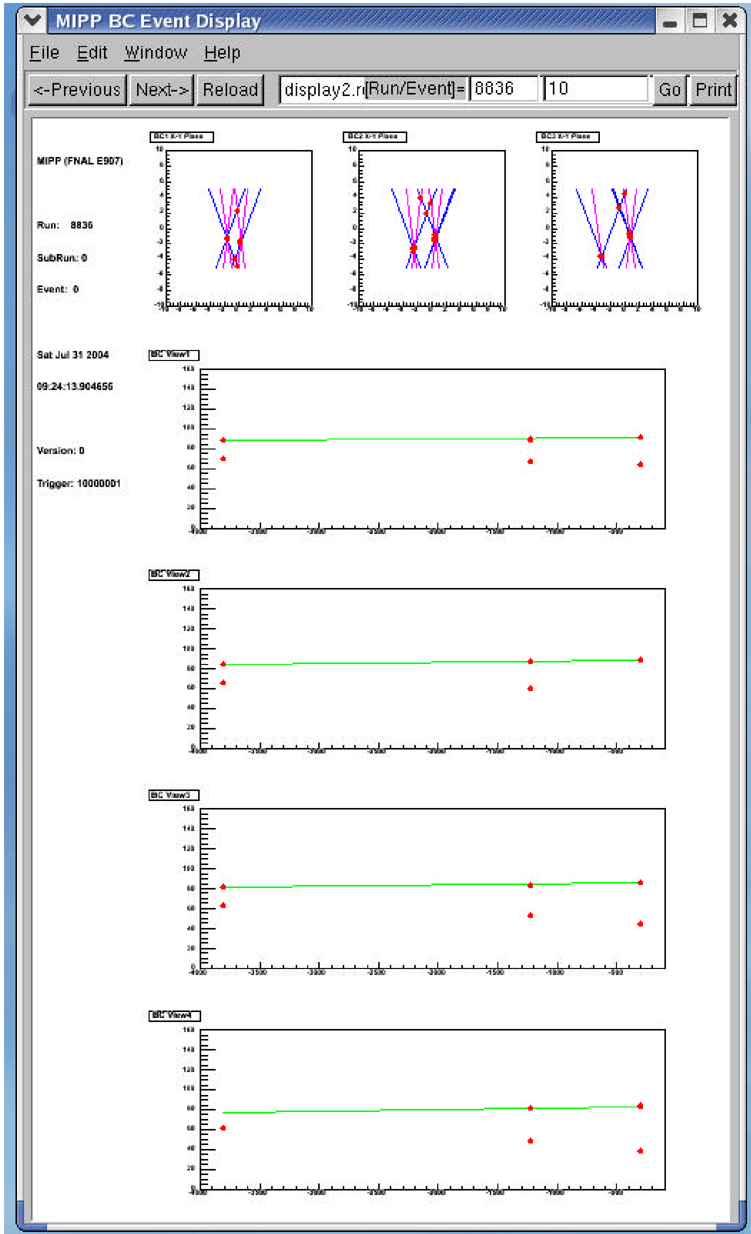
09:24:13.904656

Version: 0

Trigger: 10000001

Event Display Example ($n_{TrkFind}$=5)

$n_{ViewMatch}$=2



display2.r [Run/Event]= 8836 10

MIPP (FNAL E907)

Run: 8836

SubRun: 0

Event: 0

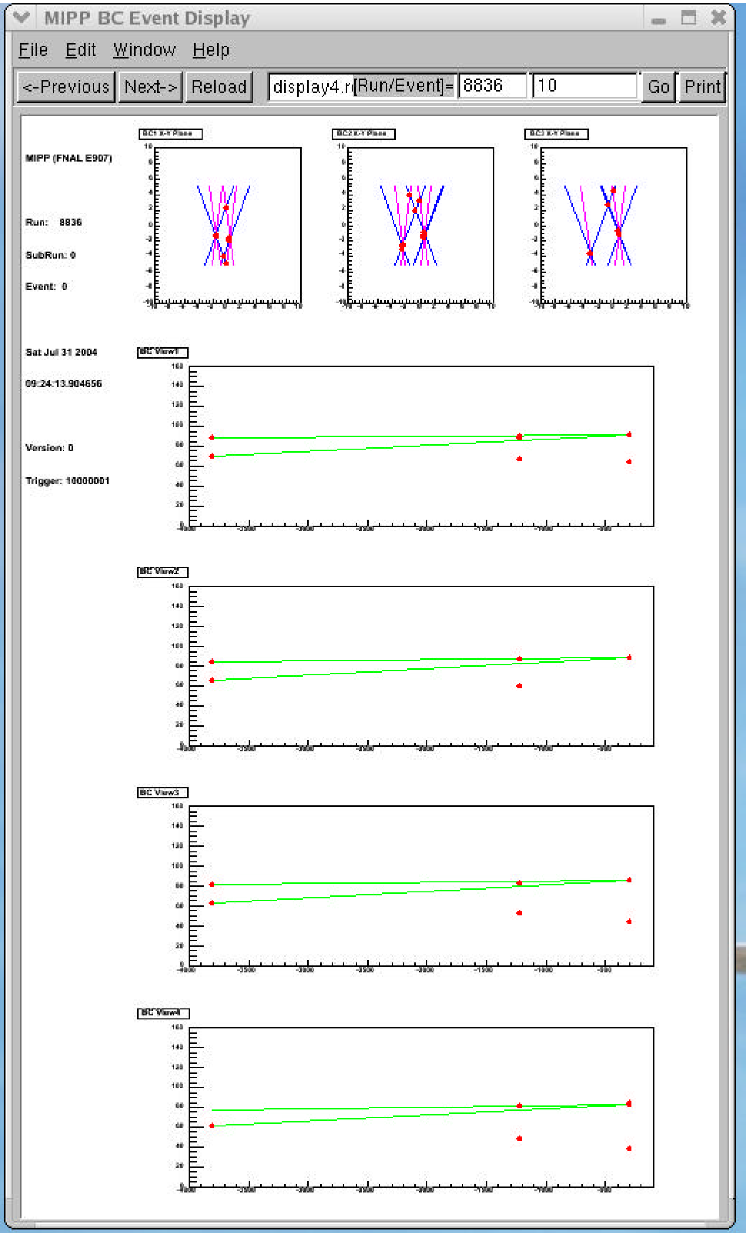
Sat Jul 31 2004

09:24:13.904656

Version: 0

Trigger: 10000001

$n_{ViewMatch}$=4



display4.r [Run/Event]= 8836 10

MIPP (FNAL E907)

Run: 8836

SubRun: 0

Event: 0

Sat Jul 31 2004

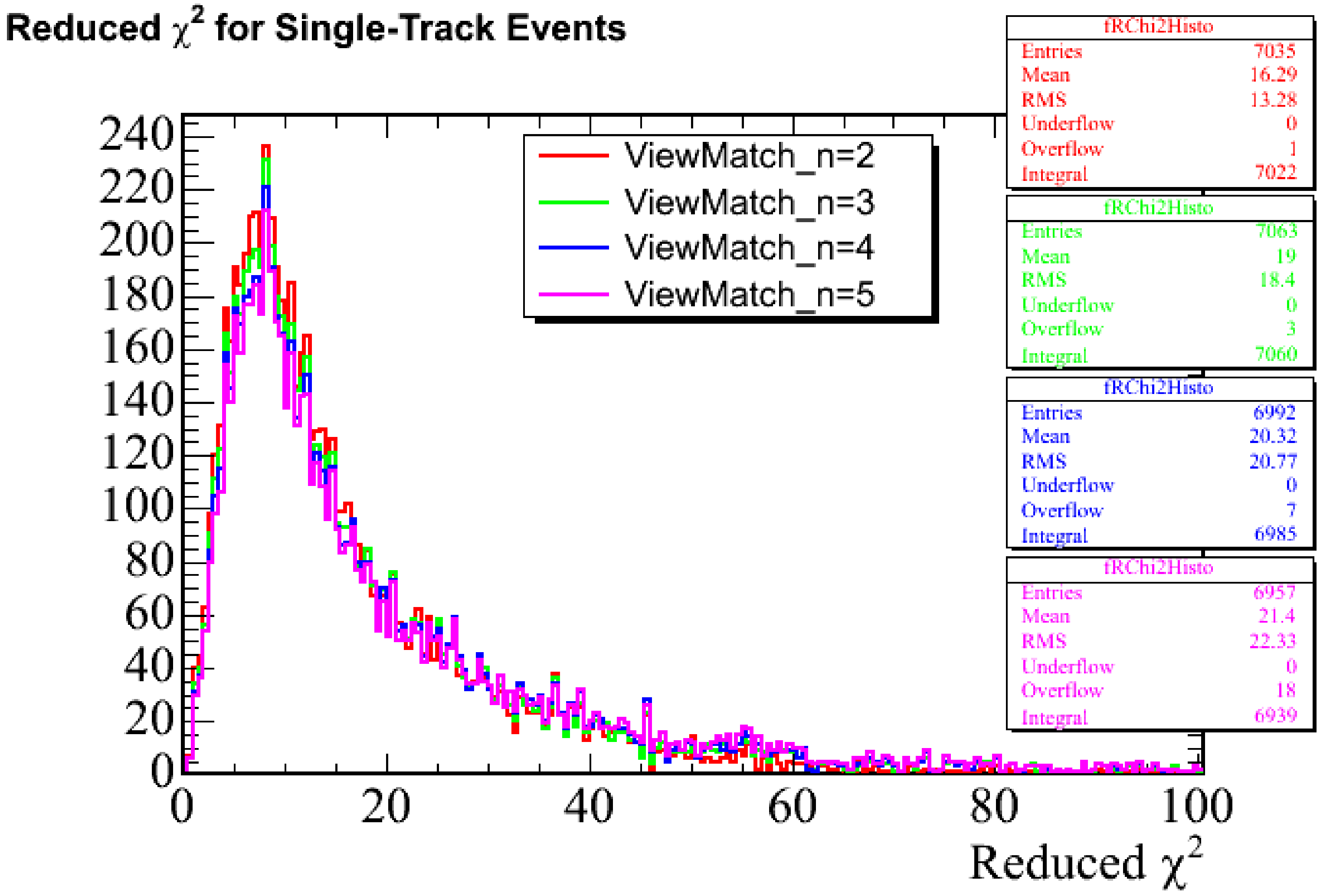
09:24:13.904656

Version: 0

Trigger: 10000001

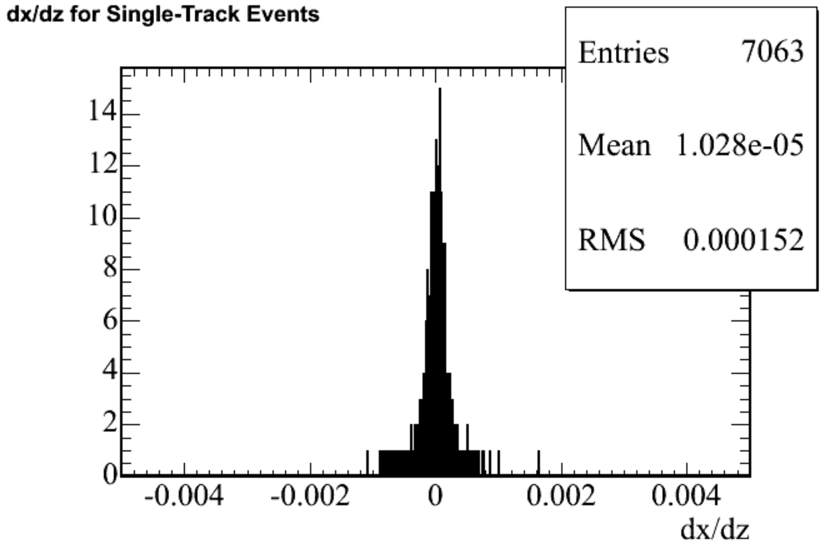
Fitting Performance: Reduced c^2

$n_{TrkFind}$=5

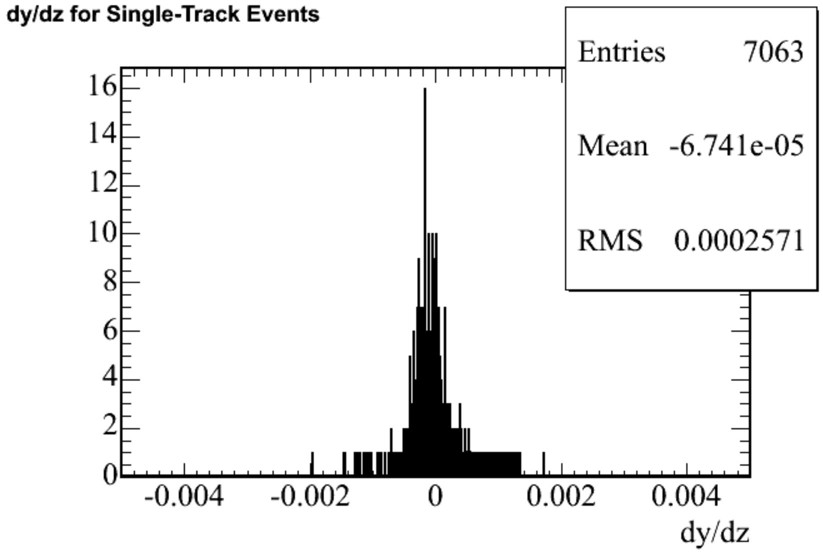


Algorithm is not strongly dependent on $n_{ViewMatch}$

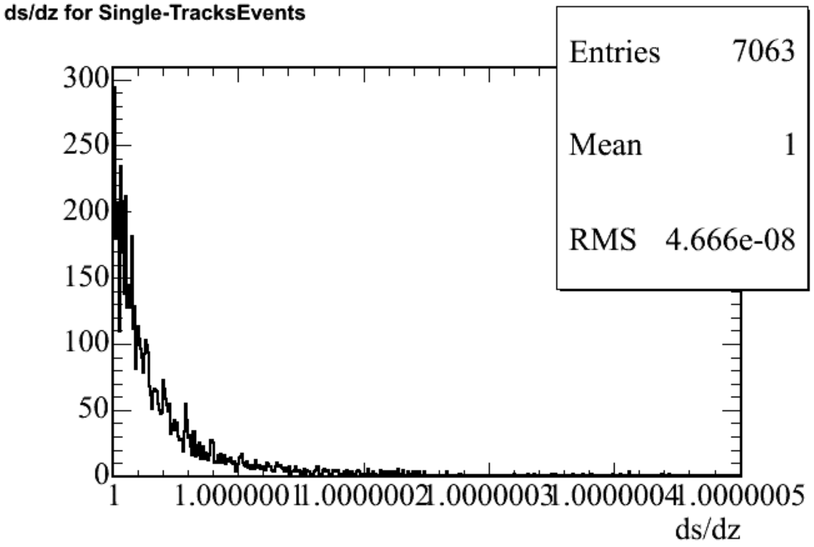
Fitting Performance: Beam Direction



dx/dz for Single-Track Events



dy/dz for Single-Track Events



ds/dz for Single-TracksEvents

$n_{TrkFind}$=5, $n_{ViewMatch}$=3

$$\frac{ds}{dz} = \sqrt{1 + \left(\frac{dx}{dz}\right)^2 + \left(\frac{dy}{dz}\right)^2}$$

Summary & Future Work

- Post BC Reconstrution

  Data Stream: Class BCLine

  ```
  BCLine l(x1, y1, z1, x3, y3, z3);
  evt.Reco().Put(l, "./bc/linefit");
  ```

- BCReco is working as expected
- Algorithm is not strongly dependent on View Matching parameter, $n_{ViewMatch}$

  $n_{\_TrkFind} = 5$, $n_{\_ViewMatch} = 3$?

- Test on MC is needed to finalize the cuts in Track Finding and View Matching
- Next: implement Hartouni's track fitting algorithm